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TREATMENT OF OATS FOR SMUT.

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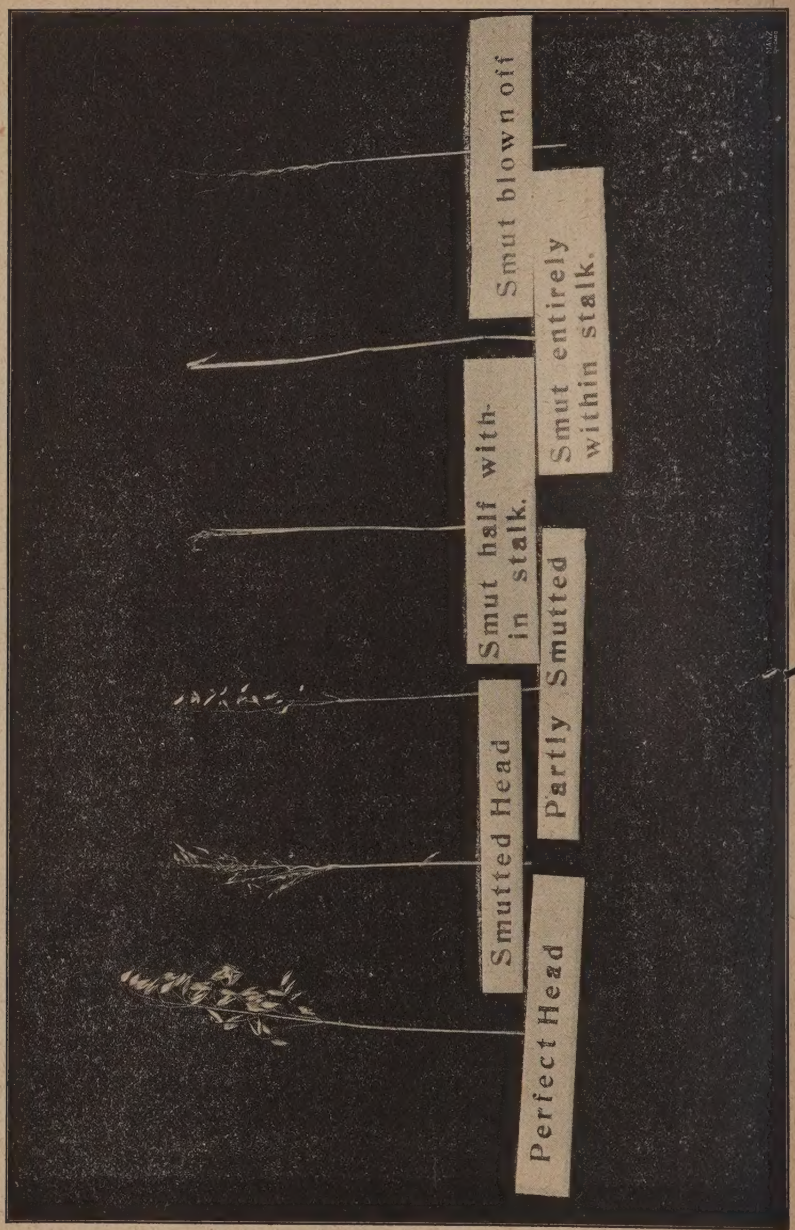
The loss to the farmers of Illinois, due to smut in the oat crop, is usually underestimated for three general reasons; viz.: 1. The smutted stalks are usually shorter than the healthy ones, and are consequently overlooked in an examination of the fields. 2. The smutted heads do not always push out of the rolled up leaves, so that these stalks are counted as merely dwarfed plants, when, if the leaves are unrolled, the heads will be found to be smutted. 3. The smut ripens several days earlier than the healthy stalks, so that by the time the oats are ripe the smut spores have been mostly whipped off by the wind, in many instances leaving a bare stalk or stub. In such cases the damage is not recognized as due to smut.

The actual per cent. of smut in any field of oats can be determined as follows: Place an ordinary barrel hoop, or light frame of any kind of convenient size, over any average spot of oats in the field. Count all of the stalks inside the hoop and note the number. Then count the stalks affected by smut and divide the number of smutted stalks by the total number of stalks. This operation repeated in three or more places in every field, in order to get an average, will determine the per cent. of smutted stalks for the entire field.

The accompanying table gives the result of careful tests made


Perfect Head
Smutted Head
Partly Smutted
Smut half within stalk.
Smut entirely within stalk.
Smut blown off

last season in almost every prominent oat growing county of the state. The per cent. of smut varies from 1 to 36 with an average over the entire state of about 14 per cent. With an oat crop of 130,000,000 bushels in Illinois in 1900 this means a loss of not less than $4,000,000 in profits to the farmers of Illinois.

The table gives the name of the farmer making the count, the postoffice address and county, the variety of oats as far as known, the number of counts made, and the average per cent. of smut.

Amount of Smut in Different Varieties Grown at the Experiment Station.

A careful count of the amount of smut in the varieties of oats tested at the Experiment Station was made last season, and the results of these tests are given in the accompanying table, together with the yield per acre of grain and straw, the weight per bushel, the time of maturity, and the color of the oats. The varieties having the small per cent. of smut, as a rule, give the largest yield per acre, while, as a general thing, the varieties with the large percentages of smut give the lower yields.

Nature of Smut.

There are two distinct smuts of oats: First, the so-called loose smut, and second, the close or covered smut. In the loose variety the smut is a dusty olive brown mass which is easily blown away by the summer wind, leaving a bare stalk. The close variety is less dusty and of a blackish brown, covered by the original hull of the oat kernel, so that in many cases the presence of the smut is undetected.

The smutted kernels are made up of a mass of minute spores or seeds, which ripen usually several days before the oat kernels ripen and just when the oat kernels are in the milky stage. At this time the hulls of the oat kernels are open, and the light smut spores floating about in the wind find a secure lodging place under the hull of the healthy kernels.

As the kernels mature and dry out, the hulls close tightly about the kernels with the smut spores inside. The spores also become attached to the outside of the kernels during threshing or in the oat bin, and in this way may also, it is believed, give rise to smutted oats.

When the kernels of oats are sown in the spring with the smut spores under the hull, or attached to the outside, the spores germinate and send slender threads into the young oat plant. The smut threads grow on the inside of the oat stalk during the months

TESTS FOR SMUT IN OATS MADE IN 1900.

Name of variety.	Place where tests were made.	No. of tests.	Per cent. smut.
Mixed	A. D. Hopps, LaMoille, Bureau Co	5	10.09
Black	H. Livergood, Milledgeville, Carroll Co	6	11.05
White	B. Springer, Virginia, Cass Co	9	12.68
Early white	J. W. Jordan, Savoy, Champaign Co	6	13.57
Mixed	C. E. Walcher, Millersville, Christian Co	8	18.80
Black	E. Barnett, Bible Grove, Clay Co	12	7.04
Mixed	J. Beckemeyer, Buxton, Clinton Co	12	11.34
Silver mine	Nellie Toland, Humbolt, Coles Co	12	13.88
Mixed	F. W. Pfingsten, Meacham, Cook Co	12	13.90
Mixed, late	W. Parr. Arcola, Douglas Co	12	11.54
Red Texas	E. Wiseman, Villa Grove, Douglas Co	12	2.50
Black, late	E. Turner, Avena, Fayette Co	3	12.75
American banner	R. Speedie, Gibson City, Ford Co	9	9.83
Fourth of July	F. A. Warner, Farm 19, Sibley, Ford Co	4	17.87
Common white	F. A. Warner, Farm 20, Sibley, Ford Co	2	11.67
Iowa banner	F. A. Warner, Farm 21, Sibley, Ford Co	2	5.57
Late, white	F. A. Warner, Farm 25, Sibley, Ford Co	2	12.10
Fourth of July	F. A. Warner, Farm 28, Sibley, Ford Co	4	36.29
Late, white	F. A. Warner, Farm 30, Sibley, Ford Co	3	11.59
Lincoln	F. A. Warner, Farm 35, Sibley, Ford Co	2	9.49
Iowa banner	F. A. Warner, Farm 38, Sibley, Ford Co	4	7.51
Medium white	F. A. Warner, Farm 49, Sibley, Ford Co	2	7.02
Late, white	F. A. Warner, Farm 133, Sibley, Ford Co	3	7.00
Calgary gray	J. H. Beagley, Sibley, Ford Co	12	9.97
Medium white	G. Hacker, Canton, Fulton Co	6	4.68
Mixed	F. Scanlon, Avon, Fulton Co	9	9.51
Mixed	F. Roobe, Schultz Mills, Greene Co	12	21.93
White	R. Clark, Elvaston, Hancock Co	9	5.83
Mixed	W. Sandquist, Colona, Henry Co	6	11.05
Mixed	C. Hurliman, Cisna Park, Iroquois Co	9	4.65
Black	H. G. Easterley, Carbondale, Jackson Co	9	1.00
Early black	F. Decker, Jerseyville, Jersey Co	12	22.24
Mixed	F. Heaton, New Burnside, Johnson Co	9	31.73
Mixed	L. Snow, Vienna, Johnson Co	12	11.86
Kansas	F. L. Viall, Manteno, Kankakee Co	12	6.08
Texas rust proof	L. Crosby, Wichert, Kankakee Co	12	2.93
Mixed	J. O. Finley, Oneida, Knox Co	15	5.72
Mixed	S. J. Haight, Jr., Mendota, Lasalle Co	9	4.52
Mixed	W. O. Perry, Cornell, Livingston Co	15	18.25
Mixed	F. Gardner, Beason, Logan Co	6	13.15
Mexican gray	F. J. Basting, Yuton, McLean Co	12	8.90
Mixed	E. J. Soloman, Carlinville, Macoupin Co	9	2.88
Early black	G. Hollenbeck, Tonti, Marion Co	12	11.47
Mixed	R. Hill, Whitefield, Marshall Co	12	8.22
Silver mine	W. W. Stone, Mason City, Mason Co	6	7.87
Early black	E. Westerman, Metropolis, Massac Co	6	6.67
Mixed	A. E. Wade, Athens, Menard Co	12	5.83
Lincoln	G. Lee, Jr., Hamlet, Mercer Co	12	24.50
Black	J. Schmidt, Hecker, Monroe Co	12	15.13
Mixed	R. J. Simonson, White Oak, Montgomery Co	12	6.42
Mixed	F. Alford, Franklin, Morgan Co	6	12.43
Texas rust proof	W. H. Rowe, Jacksonville, Morgan Co	9	1.83
Black	H. Moore, Atwood, Piatt Co	6	8.34
Early white	E. G. Ham, Perry, Pike Co	9	17.14
Early black	R. Endicott, Villa Ridge, Pulaski Co	9	13.31
Early white	W. Eckhardt, Buffalo Prairie, Rock Island Co	9	12.65
Iowa silver mine	Wm. Montgomery, Reynolds, Rock Island Co	3	4.78
Early white	F. W. Ladage, Woodside, Sangamon, Co	12	11.65
Golden medium	James L. Reid, Delavan, Tazewell Co	3	1.60
Mixed	R. Bines, Ridge Farm, Vermilion Co	12	3.47

TESTS FOR SMUT IN OATS AT UNIVERSITY OF ILLINOIS WITH YIELDS PER ACRE, 1900.

Name of variety.	Source of seed.	Grain, bu.	Wt. bu.	Straw, lb.	Maturity.	Smut, pr.ct.	Color.
Red rust proof	University of Illinois	55.4	35.5	3653	Late	1	Red
White bonanza	W. G. Baker, Champaign	55.1	32.9	4173	Medium	5	White
Lincoln	L. L. Olds, Clinton, Wis	54.7	33.2	3926	Medium	10	White
Leisman	University of Illinois	53.7	32.8	4346	Medium	8	Black
Powers	J. H. Powers, Prophetstown	53.1	32.6	4193	Medium	3	White
Silver mine	L. L. Olds, Clinton, Wis	52.9	31.9	4313	Medium	9	White
Lincoln	Iowa Seed Co., Des Moines	51.8	33	4180	Medium	4½	White
Improved white Russian	Iowa Seed Co, Des Moines	51.6	32.5	4260	Late	5	White
New Zealand	Farmer Seed Co., Faribault, Minn	49.7	32.5	4406	Late	3	White
Iowa prolific	G. W. Miner, Gibson City	49.3	33.1	4020	Late	6	White
Iowa silver mine	J. H. Beagley, Sibley	48.7	31.6	4680	Late	6	White
Russian	U. S. Department of Agriculture	48.4	36.3	4510	Medium	2¼	White
Lincoln	Johnson & Stokes, Philadelphia	48	31.8	4193	Late	9	White
Irish victor	Iowa Seed Co., Des Moines	47.4	30.3	3933	Medium	4	Mixed
White Maine	Johnson & Stokes, Philadelphia	47.2	32.6	4153	Very late	1	White
Salzer's big four	L. L. Olds, Clinton, Wis	46.8	34	4140	Medium	10½	Mixed
Black Tartarian	Peter Henderson & Sons, New York	46.2	34	3520	Very early	16	Black
Calgary gray	J. H. Beagley, Sibley	46.2	33.4	4066	Early	9	White
Illinois	J. H. Beagley, Sibley	45.8	32.1	3813	Late	5	Mixed
Great American	J. A. Everitt, Indianapolis	45.6	33.5	4166	Medium	21	Mixed
Danish	Johnson & Stokes, Philadelphia	45.4	33.3	3293	Late	22	White
Fourth of July	J. A. Everitt, Indianapolis	45	31.3	3800	Very late	1	Mixed
New welcome	Johnson & Stokes, Philadelphia	44.9	33.7	3573	Late	9	Mixed
Michigan wonder	L. L. Olds, Clinton, Wis	44.3	31	4826	Late	10	White
New Zealand	Iowa Seed Co., Des Moines	44.3	32.8	4353	Very late	1½	White
Clydesdale	Johnson & Stokes, Philadelphia	44.1	31.5	4586	Very late	9	White
Washington	Iowa Seed Co., Des Moines	42	34.5	4186	Late	5½	White
Superior Scotch	J. A. Everitt, Indianapolis	42	33.3	4343	Early	10	White
Sibley white	J. H. Beagley, Sibley	42	32.2	3800	Late	10	White
Bartley	Sam'l Bartley, Edgewood	40.7	33.7	4193	Medium	16	Mixed
Sibley black	J. H. Beagley, Sibley	34.9	34.8	3680	Late	7½	Black
New Alaska	W. W. Barnard & Co., Chicago	33.5	35	3400	Very early	14	Mixed
Early champion	Iowa Seed Co., Des Moines	30.2	35	3366	Very early	14	Mixed
Alaska	J. H. Beagley, Sibley	23.6	32.2	3773	Early	21	Mixed

of May and June, so that there is no outside evidence of the presence of the smut plant. When the oat plant begins to head out, the slender smut threads penetrate the oat kernels and develop each kernel into a mass of smut spores.

Treatment to Prevent Smut.

It has been found that it is possible to treat the seed oats so as to destroy the vitality of the spores of smut and not injure the life of the oat kernel. This treated seed will raise a crop of oats free from smut. If there are no smutted fields near by where the treated oats are grown the oats will not become smutted again for several years. It is believed that treatment once every fourth year will keep the oats practically free from smut.

Hot Water Treatment.

The apparatus needed for treating seed oats in hot water consists of an ordinary scalding kettle, one barrel, several gunny sacks, and an *accurate* thermometer. The farmer may use his ingenuity in the selection of apparatus, making use of whatever conveniences he may have at hand by which he may accomplish the desired result.

The kettle, holding from 35 to 60 gallons of water, should be filled two-thirds full, and the temperature of the water raised between 132° F. and 137° F. The barrel should be placed near the kettle of hot water, and be filled with cold water. The gunny sacks should be large enough to hold two bushels of seed oats, which can then be dipped into the hot water. The sack of oats should be stirred about in the hot water so that the oats in all parts of the bag will be treated alike. To assist in manipulating the sack, a sweep, arranged as shown in the illustration, can be used to advantage. After treating for five minutes in the hot water at the required temperature, dip at once into the barrel of cold water in order to cool the oats and prevent steam from collecting in the center of the bag. *Sow immediately without attempting to dry.*

Precautions.

1. An ordinary Fahrenheit thermometer to be had at any drug store costing from ten to fifty cents can be used after it has been compared with a standard thermometer. It should register as high as 150° F. and should be known to be correct at 135° F.

2. The temperature of the water should not be allowed to

fall below 132° F. or the smut will not be completely destroyed, nor should it rise above 140° F., as the vitality of the seed oats is likely to be injured.

3. After dipping in the hot water, the oats should be dipped immediately into the cold water to prevent over heating in the center of the sack.

4. Care should be taken to sow a sufficient amount of the soaked seed per acre. The oats being wet and swollen there is danger that too little seed will be sown. It has been found that about two pecks per acre extra measure should be used.

5. Owing to the fact that there is very little drying weather at the seeding time of the year, it is practically impossible to dry the oats and they must be sown immediately. It has been considered necessary to sow by hand, but reports received by the Experiment Station from farmers who tried sowing the wet oats in an endgate seeder indicate that this machine may be used successfully, and in the northern part of the state a number of farmers used the force feed drills for sowing the wet oats, and report success.

In case it is not desirable to treat the seed for the entire field, enough can be treated to sow four or five acres. This can be harvested and threshed separate from the rest of the field, and these oats can be used for seed the following year.

It has been found that the simple treating of the seed oats by the hot water quickens germination, and the young plants make a more vigorous growth,* thus increasing the yield independent of the smut.

Cost.

Two men in one day can treat enough seed oats to sow forty acres. The cost of treating is, therefore, next to nothing, not exceeding 10 to 12 cents per acre. Nor is it necessary to treat the seed every year in order to keep the oats free from smut, for treatment every third or fourth year will practically prevent all loss from this fungus.

Results of Treatment at Different Temperatures.

Four varieties of oats, representing the varieties of white and black oats, commonly grown in Illinois, were used in this experiment. Each variety was sown in three different plots, but as one

*Bulletin No. 87, Michigan Agricultural Experiment Station.

plot in each variety was used in getting samples for the purpose of photographing the results, the yields of only two plots in each case were secured. The seed was heated at 125°, 132°, 137°, 140° F., and in each case the treated seed was compared with a plot of untreated seed to determine the effect of treatment.

In the illustrations are shown samples of oats cut from one plot of every treatment of all four varieties. The stalks of smut were separated from the healthy stalks, counted, the per cent. of smut determined, and the smutted stalks tied into a seperate bundle. The bundles of smutted stalks were then placed beside the bundle of healthy stalks, and the per cent. of smut placed under these bundles, after which the photograph was taken, so that the illustrations show clearly the actual effect of the treatment on the per cent. of smut in the different treatments of each variety.

By reference to the accompanying tables the per cent. of smut and the yield per acre of both grain and straw can be seen. It will be noticed that the effect of treatment was not uniform in all the varieties so far as yield is concerned. The general effect of treatment at 132°–137° F. was to increase the yield per acre, while at 140° the yield of the Sibley white was reduced, probably due to injury to the seed in treating at this temperature. On the other hand, the yield of the Leisman oats at 140° was greatly increased, In all cases there is a variation due to the difference in soil or other conditions, but the general tendency is to an increased yield in the treated fields over the untreated fields.

The per cent. of smut was greatly reduced by the treatment at 125° F. while at 137° F. and 140° F. the smut was practically all destroyed by these treatments. In general it may be safely said that treatment by hot water at 137° F. will destroy the smut in the oats, and benefit rather than injure the germinating power of the oat.

SEED TREATED FIVE MINUTES, TEMPERATURE 125° F.

Variety.	Smut, per ct.	Grain per acre, bu.	Straw per acre, lb.
Sibley black No. 1	1½	50.	4560
Sibley black No. 2	2	56.20	4500
Sibley white No. 1	2	33.70	5720
Sibley white No. 2	1½	37.80	5080
Iowa prolific No. 1	5	41.80	4740
Iowa prolific No. 2	3	48.70	4280
Leisman's No. 1	1	48.70	4840
Leisman's No. 2	1½	47.50	4880

SEED TREATED FIVE MINUTES, TEMPERATURE 132° F.

Variety.	Smut, per ct.	Grain per acre, bu.	Straw per acre, lb.
Sibley black No. 1	½	48.10	4300
Sibley black No. 2	½	46.20	4680
Sibley white No. 1	1	37.80	4460
Sibley white No. 2	3½	36.80	3800
Iowa prolific No. 1	1	50.	5120
Iowa prolific No. 2	⅔	50.	4480
Leisman's No. 1	1	47.50	4880
Leisman's No. 2	0	42.50	5680

SEED TREATED FIVE MINUTES, TEMPERATURE 137° F.

Variety.	Smut, per ct.	Grain per acre, bu.	Straw per acre, lb.
Sibley black No. 1	0	43.10	4940
Sibley black No. 2	0	48.10	4700
Sibley white No. 1	1½	42.50	4560
Sibley white No. 2	½	32.50	5040
Iowa prolific No. 1	0	47.50	5120
Iowa prolific No 2	⅓	53.70	5160
Leisman's No. 1	0	42.50	4560
Leisman's No. 2	0	48.70	4840

SEED TREATED FIVE MINUTES, TEMPERATURE 140° F.

Variety.	Smut, per ct.	Grain per acre, bu.	Straw per acre, lb.
Sibley black No. 1	0	48.10	4860
Sibley black No. 2	1	37.50	4960
Sibley white No. 1	2	22.50	4560
Sibley white No. 2	½	34.30	3700
Iowa prolific No. 1	½	48.10	5100
Iowa prolific No. 2	0	51.50	4600
Leisman's No. 1	0	56.20	4700
Leisman's No. 2	0	55.	4600

SEED NOT TREATED.

Variety.	Smut, per ct.	Grain per acre, bu.	Straw per acre, lb.
Sibley black No. 1	9	36.80	5220
Sibley black No. 2	8	36.80	4420
Sibley white No. 1	8	27.50	3680
Sibley white No. 2	7	32.50	4480
Iowa prolific No. 1	8	44.30	4820
Iowa prolific No. 2	7	46.20	4440
Leisman's No. 1	2½	43.70	4640
Leisman's No. 2	2½	43.70	4360

FORMALIN TREATMENT.

The formalin treatment for smut has given such satisfactory results that this method of treatment is recommended wherever it can be given. The ordinary commercial formalin, a forty per cent. solution of formic aldehyde, was used. This material can be obtained of most druggists, or if they do not have a supply on hand they can easily secure it from a chemical supply house.

The apparatus necessary for treatment is a tub, several gunny sacks, and a supply of formalin. Use one pint of formalin to twenty-five gallons of water. Dip the seed oats in the gunny sack into the tub containing the water and formalin. The sack of oats should be so arranged that all of the oats will be submerged. Leave the sack of oats in the water for ten minutes, after which they can be taken out and sown immediately. The water need not be warm although it is less disagreeable to use warm water. If the oats are allowed to drain a few moments as the sack is lifted out of the water, the twenty-five gallons will treat twenty bushels.

Cost.

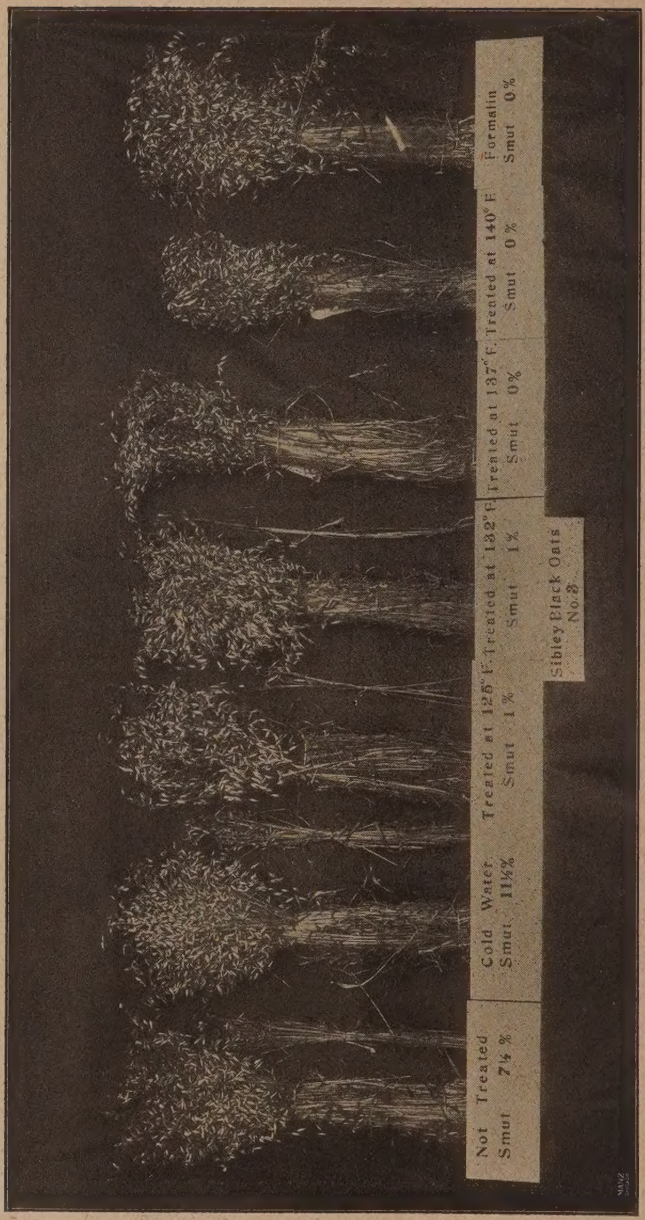
The cost is about the same as in the hot water treatment. Several barrels or tubs can be used, so that a large amount sf seed can be treated in a short time. The formalin is inexpensive not costing more than twenty-five cents per pint.

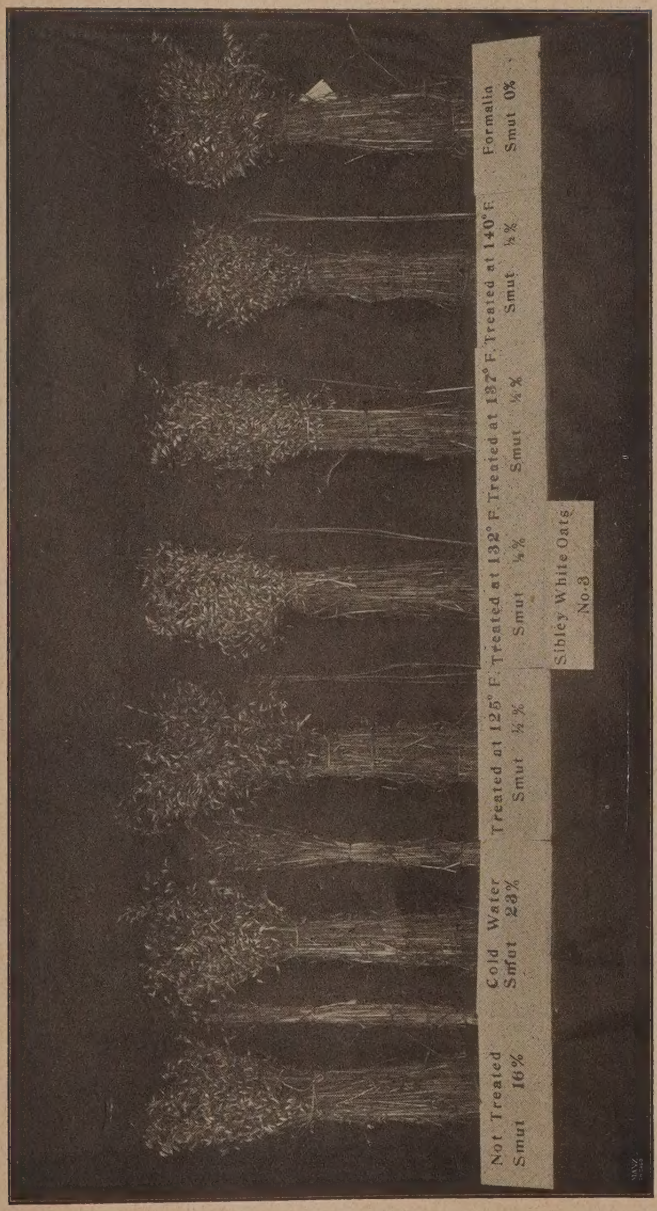
Results of Formalin Treatment.

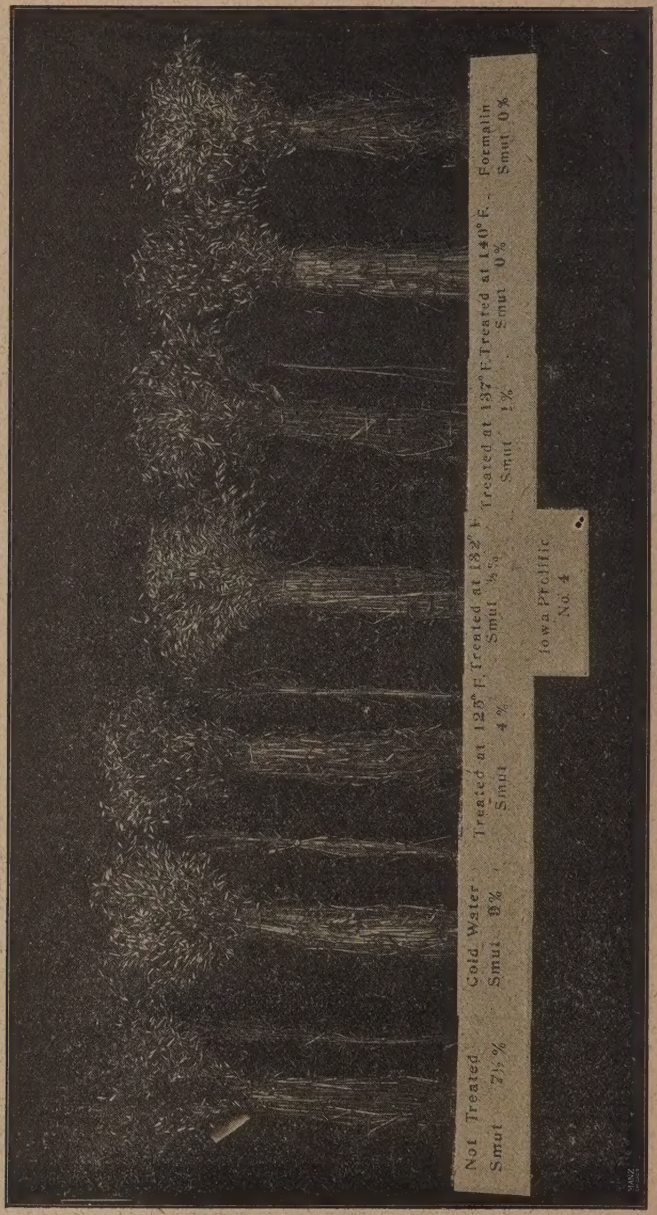
As can be seen in the illustrations and by examination of the accompanying table, the formalin treatment destroyed the smut in every variety. Similar results were obtained at Sibley and other points in the state where this treatment was tried. The yield per acre was increased and the fields were entirely free from smut.

Formalin Treatment of Seed.

Variety.	Smut, per ct.	Grain per acre, bu.	Straw per acre, lb.
Sibley black No. 1	0	48.10	4700
Sibley black No. 2	0	48.10	4060
Sibley white No. 1	0	31.20	4520
Sibley white No. 2	0	40.60	4940
Iowa Prolific No. 1	0	53.10	5340
Iowa Prolific No. 2	0	55.	5120
Leisman's No. 1	0	56.20	4840
Leisman's No. 2	0	69.30	4340


Not Treated
Smut 7¼ %
Cold Water
Smut 11%
Treated at 126° F.
Smut 1%
Treated at 132° F.
Smut 1%
Treated at 137° F.
Smut 0%
Treated at 140° F.
Smut 0%
Formalin
Smut 0%
Sibley Black Oats
No. 2.


Not Treated
Smut 16%
Cold Water
Smut 23%
Treated at 125° F.
Smut ½%
Treated at 132° F.
Smut ½%
Treated at 132° F.
Smut ½%
Treated at 140° F.
Smut ½%
Formalin
Smut 0%
Sibley White Oats
No. 3


Not Treated
Smut 7½ %
Cold Water
Smut 8%
Treated at 125° F.
Smut 4 %
Treated at 132° F.
Smut ⅛ %
Treated at 137° F.
Smut 1%
Treated at 140° F.
Smut 0%
Formalin
Smut 0%
Iowa Prolific
No. 4